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ORIGINAL PAPER

Anthropogenic disturbances and status of forest and wildlife in the dry deciduous forests of Chhattisgarh state in India

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Abstract: The advent of modern forces and the changes in socio-economic patterns of forest dwellers have increased the pressures on the forests. In order to mitigate such pressures and also to protect the forests and wildlife the model of protected areas networks has shifted and enhanced such pressures in the unprotected natural forests due to several reasons. Being a low profile category of protected status and continuous human settlements, the present study highlights the case of dry deciduous forests of Sarguja district of Chhattisgarh state of India. The major objectives of this study were to quantify the status of forests and wildlife and also to determine the extent of anthropogenic disturbances faced by the dry deciduous forests of central India. Transect and silent drive count methods were used for sampling wildlife and quadrat method was used for sampling vegetation. Besides, the local uses of various forest produces were also studied in view of understanding the people dependency on forests. The forest vegetation, in the study area, was pre-dominated by *Shorea robusta*, which had *Madhuca indica*, *Diospyrus melanoxylon* and *Buchnania lanzan* as the major companion species. The forest had either the high girth class mature tree species or the saplings. The low vegetation cover and density were due to the high anthropogenic pressures mainly in the form of heavy livestock grazing and collection of ethnobotanically important species. The study though reveals that the area is not rich in wildlife and the forest is fragmented, the area still supports some important species, which include many rare and endangered plants and animals. The findings of this study have been discussed in view of the management and conservation of the forest and wildlife in the dry deciduous forests.

Keywords: dry deciduous forest; central India; wildlife; anthropogenic disturbances; biodiversity conservation

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Introduction

The distinct climatic, edaphic and geographical conditions of central India have paved the way for establishing its floral wealth, of which the dry deciduous forests occupy a significantly large chunk of geographical areas. Generally, the dry deciduous forests are neither exceptionally species-rich nor high in numbers of endemic species. However, a large human population depends on these forests for their survival, which also forms vital habitats for several wildlife species. The complexity of dry deciduous forests has increased over the years due to their overexploitation and instant fragmentation (Myres 1992).

The state of Chhattisgarh in central India is rich in forests as well as tribal population. For centuries, these forest dwellers have been using the surrounding forest resources for various purposes. They collect plant species for food, shelter and medicine and also use to graze their livestock in the forest areas (Kala, 2009). Besides, hunting of wildlife for multiple uses is a common practice in the tribal communities and other forest dwellers of Chhattisgarh. The forest and wildlife is threatened by destruction of habitats and hunting (Gaston 1983; Dent and Wright 2009; Majila and Kala 2010). In addition to this, the advent of modern forces and changes in socio-economic patterns of forest dwellers has increased the pressures on the forests.

In order to mitigate such pressures and also to protect the biodiversity, the protected areas have been established that has shifted and enhanced such pressures on the unprotected natural forests due to several reasons. Being a low profile category of protected status and continuous human settlements, the present study area was selected, in which the natural disturbances along with anthropogenic activities have shaped the present floral and faunal diversity and their composition (Kala 2009; Dwivedi et al. 2009).

We report here on the status of forest and wildlife including the most vulnerable plant and animal species in the Sarguja district of Chhattisgarh with respect to their continued survival prospects. Attempts were also made to study the extent of distur-

bances faced by the dry deciduous forest due to anthropogenic pressures.

Methods

Study area

Sarguja is one of the forests rich districts of Chhattisgarh state in India and lies between 23º37′25″ to 24º6′17″ N latitude and 81º34′40″ to 84º4′40″ E longitude. Biogeographically, the Chhattisgarh state is placed in Deccan Plateau zone and the Sarguja district falls on the border of Deccan peninsula Chota Nagpur and Deccan peninsula Eastern Highlands (Rodgers and Panwar, 1988). The states of Uttar Pradesh, Jharkhand, Orissa and Madhya Pradesh encircle Sarguja, and the Vindhyachal-Baghelkhand region of peninsular India overlaps the southeastern part of the Sarguja (Fig. 1).

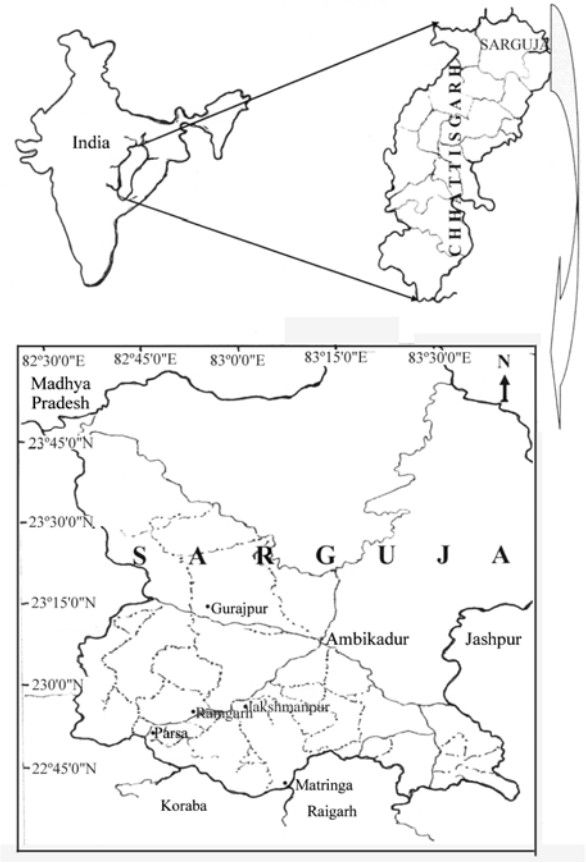

Fig. 1 Location map of the study area

Sarguja spans over 18 188.44 km^2 , of these 10 849 km^2 is occupied by forests. The forests are dry deciduous type and primarily dominated by *Shorea robusta. Madhuca indica, Anogeissus latifolia* and *Semecarpus anacardium* are the major companion species of *Shorea robusta* found in these forests. The study area is characterized by elevated flat land with a few small rounded or elongated mounds. It is incised by a number of seasonal streamlets. The annual temperature varies between 5.0–42.52ºC and humidity ranges between 26%–92%. The average annual rainfall is about 1 400 mm (Kumar 2007; Dubey and Kala 2009).

The major ethnic groups in the study area were Gond, Majhwar and Baiga. Yadav, Urawoo, Dash and Chauhan were among the other rural communities in the region. Apart from forest resource collection, the villagers practice agriculture and raise some crops, such as, paddy and maize. Comparatively, agriculture is practiced largely by the Gond tribe and livestock raring is practiced by Yadav.

Survey methods

A cross section of the area was traversed on foot for the purpose of understanding the study area. Approximately 325 km^2 area in southern part of Sarguja district was surveyed extensively for the present study. General characteristics of landscape, vegetation and land uses were noted. Assistance of local people conversant with local flora and fauna was also taken during the field visits. Standard field guides were used to aid in the identification and validation. The rare, endangered and endemic species of plants, animals and birds of the region were identified through the literature consultation. Systematic surveys of plant and animal species were conducted in the study area covering various microhabitats, altitudes, aspects and terrain types. Rapid surveys were carried out for overall assessment and characterization of landscape of the study area. The extensive network of trails and roads were used for the rapid assessment of wildlife species in the study area.

Forest structure and composition

Systematic surveys of plant species were conducted in the study area covering various microhabitats, altitudes, aspects and terrain types. The nomenclature and botanical identity of the plant species follows Witt (1916), Haines (1916), Panigrahi and Murti (1989) and Roy et al. (1992). Nested plot sampling was used to collect information on the forest structure and composition following Misra (1968). For sampling of trees, quadrat size of 10m×10m and for shrubs and saplings 5m × 5m quadrat size was used. In each quadrat, trees with ≥31.5 cm cbh (Circumference at Breast Height, i.e., 1.37 m from the ground) were individually measured for cbh. Rests of the woody individuals of ≤31.4 cm cbh were considered either as saplings/seedlings or as shrubs (as the case may be). A total of 84 plots were sampled during the survey in the study area to asses the vegetation. The frequency, density, and basal area for tree species were calculated. The importance value index was also prepared for all tree species by summing up the relative values of frequency, density and dominance. Tree saplings/seedlings and shrub species were also quantified for understanding the regeneration pattern of the forests.

Ethnobotanical observations

Ethonobotanical surveys were conducted by eliciting information through personal interviews of villagers (covering Kete, Ghatbarra, Parsa, Tara, Pendrakhi, Parogia, Hariharpur, Shivnagar, Fatepur and Bhandargaun) with the help of local people and also through direct and indirect observations made during the field

surveys. Locals who practice traditional medical practices were interviewed for information on medicinal plants, uses and availability of various medicinal plants within the study area. Besides, information was also gathered using semi-structured questionnaires on plant parts used for food, vegetable, fibers, dyes, gums, agricultural implements, etc.. Cross-checking of data was made with the help of group discussions among different age classes of tribal and non-tribal villagers. Though mainly male persons were available for interview, the females also participated during the interview. The surrounding forested area and agricultural land of villagers were also surveyed with local people for the identification of various ethnobotanical species and their indigenous uses.

Faunal diversity

Field surveys were conducted in view of identifying important habitats, resident and migratory species and communities and their corridors. The faunal surveys focused on mammals, avifauna, butterflies and reptiles. With the extensive surveys in the study area, data on presence/ absence of different faunal species were recorded largely based on direct and indirect evidences, such as, tracks, spoor, dung, calls and moults. Secondary information sources such as published information, unpublished reports, departmental records, personal communication and informal interviews with officials of various Departments and villagers were also taken into account. Standard field guides were used for identification of fauna during the surveys (Ali and Ripley 1983; Grimmet et al. 2000; Prater 1980; Haribal 1993; Blyth 1982; Evans 1932). For mammals night drive counts were also carried out in the study area to ascertain that the nocturnal species were not missed out.

Avifaunal surveys were carried out by direct sightings and also by bird calls. Point counts were also used in area where visibility was poor. At each of such point a minimum of 15 min were spent to ascertain the presence of species by way of calls or any other indirect signal that could confirm the presence of species in the study area. Butterfly counts were done by traversing the area; the walks were mainly 2–3 km long passing through all kinds of habitats and terrain and all species within 5 m square in front of the recorder were counted, with no limit on height. Where species could not be approached very closely 8×40 binoculars were used to identify species. Reptiles and amphibian were also surveyed. In addition to field observations, the villagers were inquired about the reptiles, amphibians and fishes in the area and the time they encountered them. Aquatic surveys were carried out in the stretch of rivulets, streams and ponds for fishes, amphibians and any other aquatic wildlife species.

Anthropogenic pressures

The information on anthropogenic pressures was collected by both secondary sources and by conducting interviews with local people and forest officials. Various anthropogenic pressures as visible in the form of livestock grazing, hunting of wildlife, exploitation of ethnobotanical species for food, fuel, medicine, etc., and harvesting practices of important plants were also recorded while laying quadrats for vegetation sampling and running transects for animal estimation in the study area.

Results

Floral diversity

The investigations resulted in documentation of 167 species of vascular plants in the study area. These species were distributed over 53 families and classified over different life forms. Of the total 167 plant species, 75 were tree species, 39 were shrub species, 42 were herbs, grasses and climbers and 11 were woody climber species.

Structure and composition of forests

There was diverse pattern in the distribution of various tree and shrub species. A total of 25 tree species occurred in the sampling plots (Table 1). *Shorea robusta*, locally known as Sal, was the most frequent tree species (75%), followed by *Madhuca indica* (0.37), *Diospyrus melanoxylon* (0.29) and *Buchnania lanzan* (0.26). Some of the species in the study area had high density whereas others had a low density. *Shorea robusta* had highest density (122.62 individuals·ha^{-1}), followed by *Madhuca indica* (51.19 individual·ha^{-1}), *Diospyrus melanoxylon* (32.14 individuals·ha^{-1}) and *Buchnania lanzan* (29.76 individuals·ha^{-1}). The basal area of tree species varied from species to species. *Shorea robusta* had highest basal area (13.31m^2·ha^{-1}), followed by *Madhuca indica* (2.95 m^2·ha^{-1}), *Ficus bengalensis* (2.76 m^2·ha^{-1}), *Anogeissus latifolia* (1.96 m^2·ha^{-1}), *Diospyrus melanoxylon* (1.93 m^2 m^2·ha^{-1}), *Boswellia serrata* (1.47 m^2·ha^{-1}) and *Buchnania lanzan* (1.19 m^2·ha^{-1}).

The importance value index (IVI) was calculated highest for *Shorea robusta* in the entire study area (108.50), followed by *Madhuca indica* (39.15), *Diospyrus melanoxylon* (26.95), *Buchnania lanzan* (22.94), *Anogeissus latifolia* (17.66) and *Boswellia serrata* (11.27). In general, the forest was dominated by *Shorea robusta* and thus categorized as Sal forest. *Madhuca indica, Diospyrus melanoxylon, Buchnania lanzan, Anogeissus latifolia* and *Boswellia serrata* were the major companion species of Sal forest in the entire study area. *Eugenia heyneana*, *Lagerstroemia parviflora*, *Adina cordifolia*, *Terminalia tomentosa*, *Garura pinnata*, *Phyllanthus emblica*, *Semecarpus anacardium*, *Bridelia retusa* and *Symplocos racemosa* were the other major species in terms of frequency, density and dominance found in the study area (Table 1).

A total of 15 shrub species were occurred in the sampling plots during the survey. *Flacourtia indica* was the most frequent shrub species, followed by *Ziziphus xylophyra Elaeodendron glaucum*, *Butea monosperma* and *Woodfordia floribunda*. The density of *Woodfordia floribunda* was highest (246.48 individuals·ha^{-1}), followed by *Flacourtia indica* (211.27 individuals·ha^{-1}), *Butea monosperma* (84.51 individuals·ha^{-1}), *Thespesia lampus* (77.46 individuals ·ha^{-1}) and *Ziziphus xylophyra* (77.46 individuals·ha^{-1}). In terms of IVI, *Flacourtia indica*, *Woodfordia floribunda, Ziziphus xylophyra, Butea monosperma* and *Elaeodendron glaucum* were the dominant shrub species in the Sal forest of the study area (Table 2).

Table 1. Frequency (F), density, basal area, abundance (A) and Importance Value Index (IVI) of tree species in the study area

Tree Species	Local Name	Frequency	Abundance	Density (individuals·ha^{-1})	Basal area (m^2·ha^{-1})	IVI
Adina cordifolia Hk. f.	Karmi	0.04	1.00	3.57	0.98	5.61
Albizzia procera Benth.	Kari	0.01	1.00	1.19	0.24	1.60
Anogeissus latifolia Wall.	Dhaura	0.15	1.15	17.86	1.96	17.66
Boswellia serrata Roxb.	Saliha	0.10	1.00	9.52	1.47	11.27
Bridelia retusa Spreng.	Kasayi	0.02	1.00	2.38	0.69	3.84
Buchnania lanzan Spr.	Char	0.26	1.14	29.76	1.19	22.94
Casearia graveolens Dalz.	Chilhi	0.01	1.00	1.19	0.01	0.86
Delbergia paniculata Roxb.	Dhobin	0.01	1.00	1.19	0.19	1.41
Diospyrus melanoxylon Roxb.	Tendu	0.29	1.13	32.14	1.93	26.95
Eugenia heyneana Wall.	Jamti	0.08	1.14	9.52	1.10	9.63
Ficus bengalensis L.	Bargad	0.01	1.00	1.19	2.76	9.66
Gardenia latifolia Ait.	Mali	0.02	1.00	2.38	0.04	1.76
Garura pinnata Roxb.	Kenkara	0.05	1.00	5.95	0.14	4.09
Lagerstroemia parviflora Roxb.	Sidha	0.08	1.29	10.71	0.45	7.90
Madhuca indica Gmel	Mahuwa	0.37	1.39	51.19	2.95	39.15
Odina wodier Roxb.	Gunja	0.01	1.00	1.19	0.31	1.80
Ougenia dalbergioides Benth.	Tilsa	0.01	1.00	1.19	0.11	1.18
Phyllanthus emblica L.	Awala	0.08	1.14	9.52	0.38	7.31
Schleichera trijuga Willd.	Kusum	0.01	1.00	1.19	0.08	1.07
Semecarpus anacardium L.	Bhelwa	0.05	1.00	4.76	0.31	4.26
Shorea robusta Gaertn.	Sal	0.75	1.63	122.62	13.31	108.50
Symplocos racemosa Roxb.	Lodh	0.05	1.00	4.76	0.05	3.43
Terminalia bellerica Roxb.	Baira	0.01	1.00	1.19	0.09	1.12
Terminalia chebula Retz.	Harra	0.02	1.00	2.38	0.16	2.16
Terminalia tomentosa W. & A.	Saja	0.05	1.25	5.95	0.37	4.83

Table 2. Abundance, frequency, density and importance value index (IVI) of shrub species in the study area

Shrub Species	Local name	Abundance	Frequency	Density (individuals·ha^{-1})	IVI
Antidesma diandrum Roth.	Saroti	1.00	0.01	7.04	2.92
Asparagus racemosus Willd.	Asparagus	1.00	0.02	14.08	5.84
Butea monosperma (Lamk.) Taub.	Parsa	2.00	0.07	84.51	22.28
Dendrocalamus strictus Nees	Bans	1.00	0.01	7.04	2.92
Desmodium pulchellum Benth.	Chipi	1.00	0.02	14.08	5.84
Elaeodendron glaucum Pers.	Jamrasi	1.17	0.07	49.30	18.31
Embelia robusta Roxb.	Soso phodo	1.00	0.02	14.08	5.84
Flacourtia indica (Burm. f.) Merr.	Ramkatayi	3.75	0.10	211.27	40.82
Helicterus isora L.	Aeithi	1.00	0.02	14.08	5.84
Ipomoea carnea Jacq.	Ipomoea	6.00	0.01	42.25	6.89
Phyllanthus emblica L.	Awala	1.50	0.02	21.13	6.63
Ricinus communis L.	Arandi	1.00	0.01	7.04	2.92
Thespesia lampus Dalz.	Masbandi	5.50	0.02	77.46	12.98
Woodfordia floribunda Salisb.	Dhawayi	8.75	0.05	246.48	36.28
Ziziphus xylophyra Willd.	Dhontu	1.57	0.08	77.46	23.61

The saplings/seedlings of 30 tree species were found in the sampling plots. The frequency of *Diospyrus melanoxylon* was recorded highest, followed by *Shorea robusta, Buchnania lanzan* and *Madhuca indica*. The density of *Shorea robusta* saplings/seedlings (7 788.73 individuals·ha^{-1}.) was highest, followed by *Diospyrus melanoxylon* (6683.10 individuals·ha^{-1}.) and *Terminalia tomentosa* (1 056.34 individuals·ha^{-1}). Apart from these species, the other species which had relatively high saplings/seedlings in the study area were *Madhuca indica*, *Cordia macleodii, Buchanania lanzan, Anogeissus latifolia, Pterocarpus*

marsupium and *Holarrhena antidysenterica* (Table 3).

Table 3. Distribution pattern of tree saplings/seedlings in the study area

Tree Sapling	Local name	Abundance	Frequency	Density (individuals·ha^{-1})	IVI
Adina cordifolia Hook. f.	Karmi	1.00	0.04	21.13	0.79
Anogeissus latifolia Wall.	Dhaura	4.00	0.18	422.54	5.49
Bauhinia variegata L.	Champa	1.00	0.02	14.08	0.53
Bombax malabaricum DC.	Semer	1.00	0.02	14.08	0.53
Buchanania lanzan Spr.	Char	2.58	0.51	781.69	13.67
Careya arborea Roxb.	Kumahi	1.00	0.06	35.21	1.32
Casearia graveolens Dalz.	Chilhi	1.81	0.43	457.75	10.50
Cordia macleodii H. f. & Th.	Dhahjar	7.43	0.17	732.39	6.75
Delbergia paniculata Roxb.	Dhobin	1.00	0.04	21.13	0.79
Diospyrus melanoxylon Roxb.	Tendu	13.37	0.85	6683.10	48.55
Eugenia heyneana Wall.	Jamti	1.00	0.02	14.08	0.53
Ficus religiosa L.	Pipal	1.00	0.01	7.04	0.26
Gardenia latifolia Ait.	Mali	21.50	0.02	302.82	1.92
Gardenia turgida Roxb.	Khadhar	2.11	0.11	133.80	2.72
Garura pinnata Roxb.	Kekad	1.00	0.11	63.38	2.38
Holarrhena antidysenterica Wall.	Korya	2.71	0.20	323.94	5.48
Hymenodictyon excelsum Wall.	Pote	1.00	0.04	21.13	0.79
Lagerstroemia parviflora Roxb.	Sidha	1.48	0.30	260.56	7.01
Madhuca indica Gmel	Mahuwa	3.34	0.38	753.52	11.00
Odina wodier Roxb.	Gunja	2.25	0.05	63.38	1.23
Ougenia dalbergioides Benth.	Sadhan	6.50	0.02	91.55	0.90
Pterocarpus marsupium Roxb.	Bija	4.55	0.13	352.11	4.23
Saccopetalum tomentosum H. f. & Th.	Kari	1.25	0.10	70.42	2.18
Semecarpus anacardium L.	Bhelwa	1.14	0.08	56.34	1.88
Shorea robusta Gaertn.	Sal	17.02	0.77	7788.73	52.50
Sterculia urens Roxb.	Khurul	2.78	0.11	176.06	2.92
Symplocos racemosa Roxb.	Lodh	1.00	0.01	7.04	0.26
Terminalia chebula Retz.	Harra	1.50	0.02	21.13	0.56
Terminalia tomentosa W. & A.	Saja	5.00	0.36	1056.34	12.00
Wrightia tomentosa Roem. & Sch.	Dudhiya	1.00	0.01	7.04	0.26

The regeneration pattern in tree species was much uncertain with many tree species. The saplings/seedlings of 7 tree species were not encountered in the sampling plots during the survey, although these tree species were found in the study area. These species were *Albizzia procera*, *Boswellia serrata*, *Bridelia retusa*, *Ficus bengalensis, Phyllanthus emblica, Schleichera trijuga* and *Terminalia bellerica*. Similarly, 11 tree species were only encountered in the sapling/seedling stage and no mature tree species was encountered in the sampling plots. These species were *Bauhinia variegata*, *Bombax malabaricum*, *Careya arborea*, *Cordia macleodii*, *Ficus religiosa*, *Gardenia turgida*, *Holarrhena antidysenterica*, *Hymenodictyon excelsum*, *Pterocarpus marsupium, Saccopetalum tomentosum* and *Wrightia tomentosa*.

Collection of non timber forest products

The study reported 73 plant species used by tribal and non-tribal communities of Sarguja district. These ethnobotancial species had diverse uses viz., medicine, beverages, vegetables, tonic, fish poison, mosquito repellent and as dying clothes. Of the total ethnobotanical species, the highest numbers of plant species (n=36) were used in curing different types of diseases, followed by wild edible plants (n=22). Different plant parts of these species such as root, tuber, leaf, fruit, bark, resin, seed, latex etc. were used as medicine. In majority of cases, root (14 species) was used for preparing medicine, followed by fruit (7 species) and bark (5 species). More than one plant parts of 4 plant species, such as, *Ficus bengalensis, Garura pinnata*, *Helicterus isora* and *Holarrhena antidysenterica* were used as medicine. Cough, bodyache, dysentery, cut-wounds, scorpion bite, snake bite, muscular pain, indigestion, etc were among the ailments cured by using these plant species.

Status of threatened plant species

Of the total plant species found in the study area, 18 species fall under various threat categories. *Acorus calamus* is the endangered species as categorized by the IUCN red list criteria. This species was found in the marshy and water logged areas. There are reports on declining population of *Acorus calamus* through-

out Chhattisgarh over the past decade (Ved et. al. 2003). This species is widely used for medicine, and exploitation for preparing herbal drug is rated as possible threat for its survival in the wild. A total of 12 species viz., *Boswellia serrata, Celastrus peniculata, Chlorophytum tuberosum, Costus speciosus, Curcuma angustifolia, Dioscorea bulbifera, Gloriosa superba, Peucedanum nagpurense, Phyllanthus emblica*, *Pterocarpus marsupium*, *Sterculia urens,* and *Terminalia chebula* are vulnerable in the study area and are also used by local people for curing various types of ailments. There are 5 plant species growing in the study area, which have been categorized as near threatened species.

Faunal diversity and composition

The survey reported the occurrence of 15 species of mammals, 82 species of birds, 23 reptiles, 63 butterflies, 27 spiders and 10 species of fishes in the study area. Other than Rhesus macaque, Common Indian langur, Common Indian Mongoose, hyena and five stripped squirrels, there were no direct sightings of mammalian species in the study area. Of the total mammalian species reported to occur in the study area, only Asian elephant and sloth bear are from Schedule I of the Wildlife Protection Act 1972 (Table 4). Wild dogs are reported in the census data of the study area but during the survey their presence could not be confirmed either by direct sightings or by any of the indirect means including interviews with local people. Though the area was rich in avian diversity, mostly generalist species were seen. One species belonging to Schedule I of the Wildlife Protection Act (WPA 1972), namely, Indian Peafowl was found in the Ramgarh Protected Forest. This area is naturally protected by local people as it is pilgrimage site. Apart from this no species belonging to Schedule I of the WPA 1972 is reported to occur in the study area.

Table 4. List of mammals seen or reported from the study area

Common name	Scientific name	Sighting	WPA status
Barking Deer	*Muntiacus muntijac*	No evidence/ reported	Schedule III
Sāmbhar	*Cervus unicolor*	No evidence /reported	Schedule III
Spotted Deer	*Axis axis*	No evidence/ reported	Schedule III
Common Langur	*Presbytia entellus*	Direct evidence	Schedule II
Rhesus macaque	*Macaca mulatta*	Direct evidence	Schedule II
Elephant	*Elephus maximus*	Indirect evidence	Schedule I
Flying fox	*Pteropus gingantens*	Seen	Schedule V
Sloth bear	*Melursus Ursinus*	Indirect evidence	Schedule I
Jungle cat	*Felis chaus*	No evidence/ reported	Schedule II
Striped hyena	*Hyena hyena*	Indirect sighting	Schedule III
Jackal	*Canis aureus*	Seen	Schedule II
Five striped Squirrel	*Funambulus Pennanti*	Seen	Schedule IV
Field Rat	*Bandicota bengalensis*	Seen	Schedule V
Bandicoot	*Neosocia bandicota*	Seen	Schedule V
House Rat	*Rattus rattus-refescena*	Seen	Schedule V
Indian Hare	*Lepus nigricollis*	Indirect evidence	Schedule IV
Indian wild Boar	*Sus scrofa*	Indirect evidence	Schedule III
Common Indian Mongoose	*Herpestes edwardsi*	Seen	Schedule IV

Among reptiles there were direct sighting of Rat snakes, Cobra and Common Krait in the study area. Few moults of a Rat snake (*Ptyas mucosus*) were also found in the study area. House Gecko (*Hemidactylus flaviridis*) was commonly seen. Common Skink (*Mabuya carinata*) and Garden Lizards were also commonly seen. Discussions with local people did confirm the presence of Krait (*Bungarus caeruleus*), Saw's scaled viper (*Echis carinatus*), and Russell's viper (*Vipera russellii*). Rat snakes were fairly common in the forest area close to the human settlements as the people store paddy in their houses, which attracts rats and bandicoots and in turn attract Rat snakes. Of all the species of reptiles seen and reported from the area only Indian Rock Python is protected under Schedule I of WPA 1972.

The butterfly richness was higher in the areas that appeared to be disturbed by human and livestock interference. Openings created in the disturbed areas served as good habitats for butterflies by letting enough sunlight to reach the ground. All such openings in the forest area provide excellent feeding and breeding habitats to the butterflies. Natural small openings in forest also provided excellent habitat for basking and flowering plants to come up in these forests. The moist patches in riverine areas also attracted butterflies. Possibly these moist patches act as source of minerals for butterflies as many of them were seen sitting over such patches. Areas in vicinity of natural drains close to the villages provided excellent habitats for butterflies. Spiders were seen all over the study area. The orb making spiders were more common in areas where there were clearly marked aerial galleries for insect movement. These spiders were commonly seen in the tall Sal trees and large aerial galleries. Besides, a total of 10 fish species were recorded based on the interviews with the local fisherman. Most of the fish species were reported from the Atem River and Choti Chorni river of the study area.

Discussion

The findings of this study reflect that the forest vegetation in the study area is pre-dominated by *Shorea robusta*, which have *Madhuca indica*, *Diospyrus melanoxylon* and *Buchnania lanzan* as the major companion species. The forest has either the high girth class mature tree species or the saplings/seedlings of these tree species. The middle canopy or the middle girth class tree species have low availability. The ground vegetation was also poor. The low vegetation cover and density are due to high anthropogenic pressures mainly in the form of heavy livestock grazing and collection of ethnobotanically important species.

The forest, though, low in tree and shrub density, 18 species of plants found here fall under various threat categories as per the IUCN norms. Some of the rare species were not encountered in the sampling plots during the survey due to low population size and restricted distribution pattern. For example, none of the mature individual of *Sterculia urens* encountered in the sampling plots, however its saplings/seedlings were found. *Peucedanum nagpurense* was one of the threatened species, very low in frequency and density, and did not occur in the sampling plots during the survey. Studies conducted elsewhere have reported simi-

lar observations and causes for species rarity (Gitzendanner and Soltis 2000; Shahabuddin 2003; Kala, 2005).

There were different types of pressures on threatened plant species as destructive harvesting of plant parts, in case of fruits of *Phyllanthus emblica*, was the major cause of concern. The entire fruit bearing twig of *Phyllanthus emblica* was broken in most of the cases for gathering fruits. The populations of *Gloriosa superba* are under pressure due to overharvesting of its rhizome and seeds from the wild as these plant parts are traded in local to international market. Underground plant parts such as tubers of *Dioscorea bulbifera* are collected for trade and used as medicine. Though *Dioscorea bulbifera* has a wide range of distribution but due to over-collection, there has been a continuous decline of this species in the wild. Similar observations are made by Kala (2000, 2010) with respect to the impact of trade in threatened plant species occurring in other states of India. In case of *Costus speciosus* due to early harvesting of rhizomes, seed formation is scanty and thus creating problem for its regeneration. Seed collection of *Celastrus paniculata* has affected the regeneration of this species in the wild. *Celastrus paniculata* does not grow easily and thus there is a difficulty in cultivation at large scale of this species. Extensive use of some of the rare species, such as, wood of *Boswellia serrata* for packing and plywood is leading to depletion of its population in the wild. *Boswellia serrata* has poor regeneration capacity as evident in the present study that saplings/seedlings were not encountered in the sampling plots.

With respect to faunal habitats, the rocky and bouldery areas appeared suitable for Sloth bears which are quite common in the study area. Some of the dense patches of forests appear to be moderately good bear habitat. Forested areas in the vicinity of the human settlements were good habitats for Hyenas and jackals. Hyenas were reported only close to the human habitations. Sloth bear was more or less uniformly distributed as per the sighting records, and the indirect evidence encountered during the field survey. There have been few cases of mauling by Sloth bear. The study area also forms the corridor for the movement of elephants. While moving through the forests during their stay for a few days in the study area they mostly invade villages for food at night and during early morning hours. Northern Chhattisgarh is known to be the home of elephants for historical past (Forsyth 1889). However, they became locally extinct in the early part of the twentieth century (Krishnan 1972). In 1988, elephants migrated from Jharkhand into Chhattisgarh and for the first time, caused extensive damage to life and property. In 1993, the then Madhya Pradesh government captured 10 elephants in order to prevent any further invasions of elephants into Chhattisgarh. Just two years after this operation, i.e. from 1995 onwards, elephants have regularly gained access to Chhattisgarh.

A herd of six elephants - 2 adult males, 1 young male and 3 female has been visiting for last 5 years in the study area. The discussion with the villagers revealed that earlier the herd strayed into the agricultural fields of Kete and Parsa villages causing damage to the standing crops only. At present, the herd strayed into the outskirts of villages and caused rampant damages to houses. The herd size is consistent for last 3 years. The indirect sightings of elephant are visible in the form of broken houses, robbed granaries and foot prints of elephants in the villages and human settlement.

Anthropogenic pressures and forest management issues

The present study reflects that the area is not rich in wildlife. As per the wildlife census of Forest Department, the population status of mammals shows low density (Table 5). The overall habitat condition in the study area was not good, owing to tremendous amount of grazing pressure. Livestock grazing is a serious problem for wildlife (herbivores) in the study area. The local villagers own a large number of livestock mostly cows and bullocks, a few buffalos and goats in some areas. Grazing causes serious damage to the vegetation. It impacts the undergrowth and reduces the fodder availability for other wildlife in the area (Madhusudan 2004). It affects the regeneration by causing damage to the fresh seedlings, contributes to proliferation of weeds, and reduces the population of threatened plant species and also the quality of the habitat for wild herbivores (Rajmanek and Richardson 1996; Grime 1997; Kala 2004; Madhusudan 2004; Anitha et al. 2009). All these facts are very much evident in the study area especially in the forested areas in close vicinity of the settlements.

Table 5. Population status of wild mammals in the study area

Species	Total numbers
Barking deer	14
Common Langur	328
Sloth Bear	71
Jackal	137
Wild Pig	11
Rhesus macaque	260
Hyena	08
Wild dog	35

Source: Forest Department, Chhattisgarh census records 2005

There was also tremendous hunting pressure in the area. Tribal people move with bow and poisonous arrow for hunting in the forest. Uncontrolled poaching in the area for a long time is one of the reasons that the study area is not rich in wildlife although the habitat is indicative of suitability for wildlife. Local people now feel that it is not so easy to get wild animals. The disturbance signs are prevalent and can be seen in the entire stretch of the study area. There is also immense lopping pressure in the area.

The villagers in the study area depend to a very large extent on firewood for their needs of domestic fuel including cooking and heating. Considerable amount of small and large trees for firewood are being cut around all villages. The trees are also used by the tribal living over there to meet their construction related requirements. Charcoal making was also one of the activities being carried out by some villagers in the area. Fishing is another

source of livelihoods, and for this purpose the local people had discovered many plant species as a fish poison, which they spread in the ponds after crushing to powder. *Acacia caesia*, *Chloroxylon swietenia, Costus speciosus*, *Ougenia dalbergioides*, and *Randia dumatorum*, were used as fish poison by the local people.

Careless exploitation of forest and wildlife has far-flung negative effects, which include the degradation of extremely valuable natural resources and receding ecosystem services. Such exploitation produces only some short term benefits. To protect the wildlife and forests, the forested areas need protection by reducing the dependency on activities that encroach upon or diminish natural resources. Plant species, for instance, *Acorus calamus* that occurs in the special habitats, such as, water logged and marshy areas needs special care and protection of such habitats. The *ex-situ* conservation of ethnobotanically useful species should be done at the large scale for meeting the livelihoods of local people as well as for conservation of genetic diversity.

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